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14. ABSTRACT
Neurological soft signs (NSS) are subtle indicators of brain dysfunction. NSS have been found to be elevated in a variety of mental disorders, including post-traumatic stress disorder (PTSD), but they have scarcely been studied in TBI. The present study in progress measured NSS in the acute aftermath of a mTBI and evaluated their ability to predict subsequent postconcussive symptoms. We have finished all study recruitment and enrollment to date. Only data analysis remains. We screened 99 subjects via the Massachusetts General Hospital Emergency Department leading to 21 viable subjects that were enrolled, three of whom were subsequently excluded for not meeting eligibility criteria. One additional subject was lost to follow-up after completion of the first visit. The remaining 17 enrolled subjects have successfully completed the full three-month protocol. The video-recorded data for 15 subjects was encrypted and analyzed by our off site consultant, Dr. Gurvits, the originator of the NSS battery in current use. The remaining 2 subjects' data await analysis. Preliminary data analyses have been performed.

15. SUBJECT TERMS- PTSD; Postconcussive Syndrome; Neurological Soft Signs.

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1. INTRODUCTION

Neurological soft signs (NSS) are subtle indicators of brain dysfunction. NSS have been found to be elevated in a variety of mental disorders, including post-traumatic stress disorder (PTSD), but they have scarcely been studied in TBI. The present study in progress is measuring NSS in the acute aftermath of a mTBI and evaluating the ability of NSS to predict subsequent postconcussive symptoms.

2. BODY

Human subjects approvals were obtained from the Partners Health Care System and the Spaulding Rehabilitation Hospital Institutional Review Boards (IRBs) and the Department of Defense IRB. The performance and recording of the neurological soft signs (NSS) examination was rehearsed, and all necessary questionnaires and instruments were collected. Methods of encryption and safe transport of the video-recorded data to off-site consultant Dr. Gurvits, the originator of the NSS battery in current use, were developed and rehearsed. Recruitment strategies were developed and implemented in the Emergency Department at the Massachusetts General Hospital (MGH ED). Subject screening and enrollment began in September of the 01 year (month 4). To date, 99 subjects were screened MGH ED leading to 21 viable subjects that were enrolled. Two subjects were subsequently excluded after a positive urine screen. One was excluded after a significant score on the Michigan Alcohol Screening Test. One additional subject was lost to follow-up after completion of the first visit. The remaining 17 enrolled subjects have successfully completed all three study visits (96-hour post-mTBI, 1-month post-mTBI, and 3-month post-mTBI) including neuropsychological testing and questionnaires. The video-recorded data for 15 subjects was encrypted and scored by our off site consultant, Dr. Gurvits, the originator of the NSS battery in current use, and subsequently analyzed. The remaining 2 subjects' data await analysis. We received a no-cost extension from May 20 to November 19 in order to complete and sufficiently analyze our original enrollment targets.

3. KEY RESEARCH ACCOMPLISHMENTS

We have concluded all study recruitment. Partial data on 15 completed subjects were presented at the Society of Biological Psychiatry 68th Annual Scientific Convention, May 16-18, 2013, in San Francisco, CA (see REFERENCES).

Only final data analysis remains.

4. REPORTABLE OUTCOMES

We have obtained the following preliminary results: Average NSS level was modestly elevated at Day 4 and improved significantly over time: one-way repeated measure ANOVA, $F(2,28)=21.1$, $p<0.001$, with most of the improvement seen within 30 days

(**Appendix A**). Two out of 15 subjects met DSM-IV criteria for Post-Concussive Syndrome at 90 days. Both had histories of prior depression. There were no significant associations between average NSS level at Day 4 and self-reported post-concussive symptoms or functional incapacity at Day 30 or Day 90 (**Appendix B**: Correlation between average NSS level at Day 4 and RPG, BC-PSI, and MPAI-4 at Day 90). Early depressive mood was highly predictive of later post-concussive symptoms and functional incapacity (**Appendix C**: BDI-II at Day 4 correlated with RPG, BC-PSI, and MPAI-4, at Day 90). Depressive mood also improved over time: $F(2,28)=5.6$, $p<0.009$. Results obtained using a truncated version of the BDI-II that included only affective items and eliminated cognitive, vegetative, and physical items (i.e., items potentially directly related to concussion) were nearly identical to the results obtained with the full BDI-II.

5. CONCLUSION

A selected sub-set of soft signs were mildly elevated in the acute aftermath of mTBI and improved over time. Heel Walking stood out as the most elevated measure, and this could easily be incorporated into a bedside or sideline post-injury clinical examination**.** However, contrary to expectations, the Neurological Soft Signs Battery, the prime focus of our study, proved ***not*** to predict postconcussive outcome. In contrast, acute post-mTBI depressive symptoms ***did*** predict chronic postconcussive complaints and self-reported functional impairment. It is possible that the early post-mTBI depressive symptoms observed were pre-existing, although their improvement over three months militates against this. Alternately, early depressive manifestations may have resulted directly or indirectly from the mTBI, possibly even due to concussion-induced brain changes.

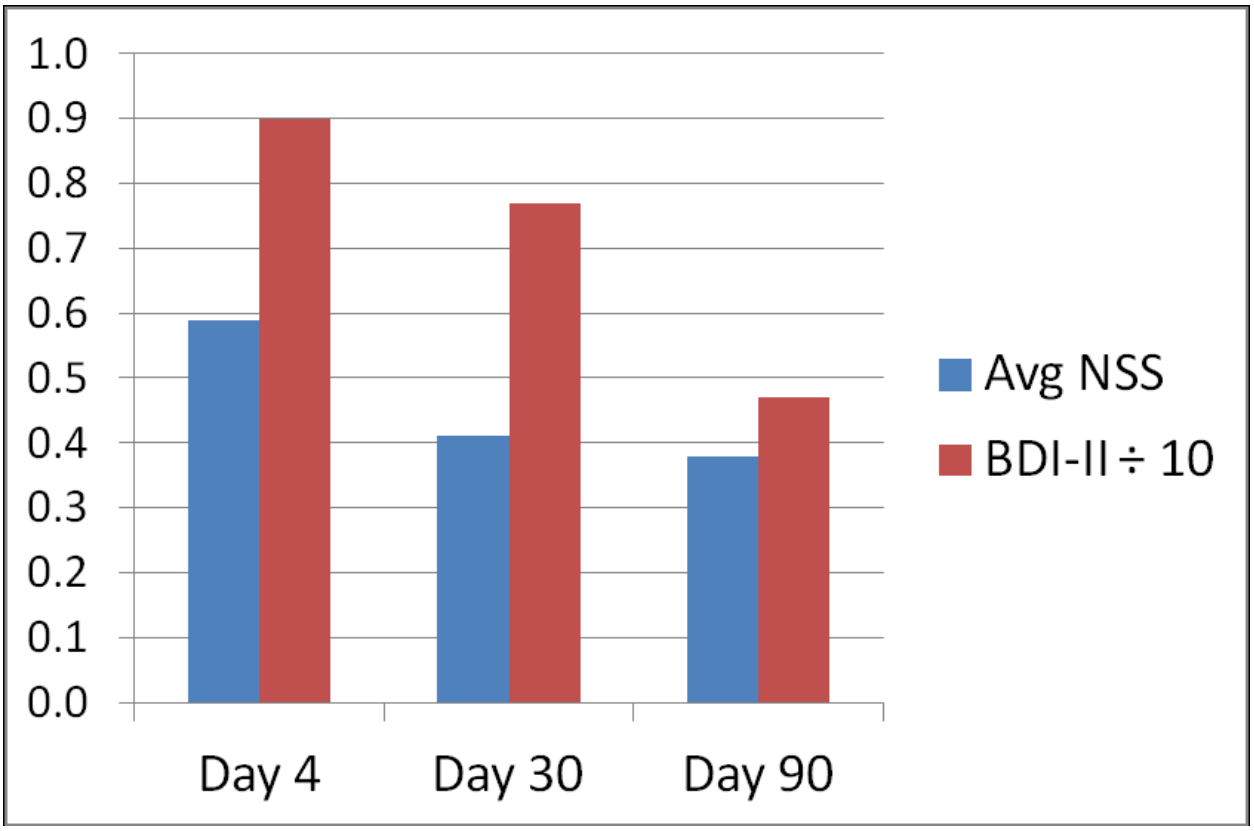
Final data analyses of remaining measures including the BESS, neuropsychological questionnaires, and NSS data including the final two subjects remain.

6. REFERENCES

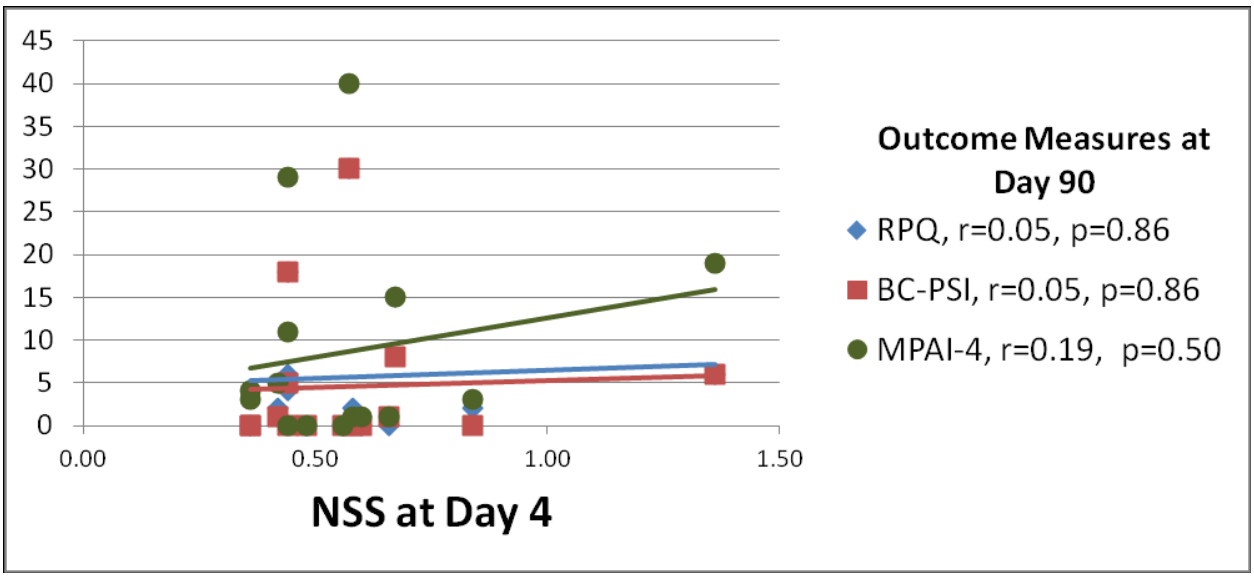
Greenberg MS, Wood NE, Spring JD, Nagurney JT, Zafonte RD, Gurvits TV, Pitman RK. Neurological soft signs in mild traumatic brain injury. *Biological Psychiatry* 2013:73: 208S.

7. APPENDICES

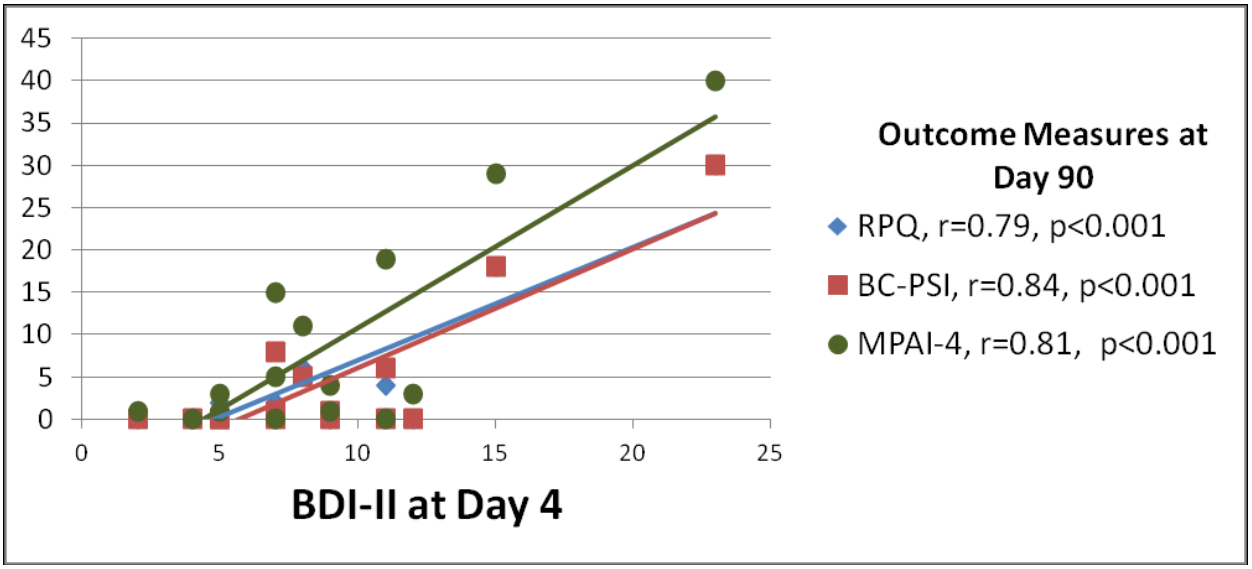
A


1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Day 4
Day 30
Day 90
Avg NSS
BDI-II ÷ 10

B


45
40
35
30
25
20
15
10
5
0
0.00
0.50
1.00
1.50
NSS at Day 4
Outcome Measures at Day 90
RPQ, r=0.05, p=0.86
BC-PSI, r=0.05, p=0.86
MPAI-4, r=0.19, p=0.50

C


45
40
35
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25
BDI-II at Day 4
Outcome Measures at Day 90
RPQ, r=0.79, p<0.001
BC-PSI, r=0.84, p<0.001
MPAI-4, r=0.81, p<0.001